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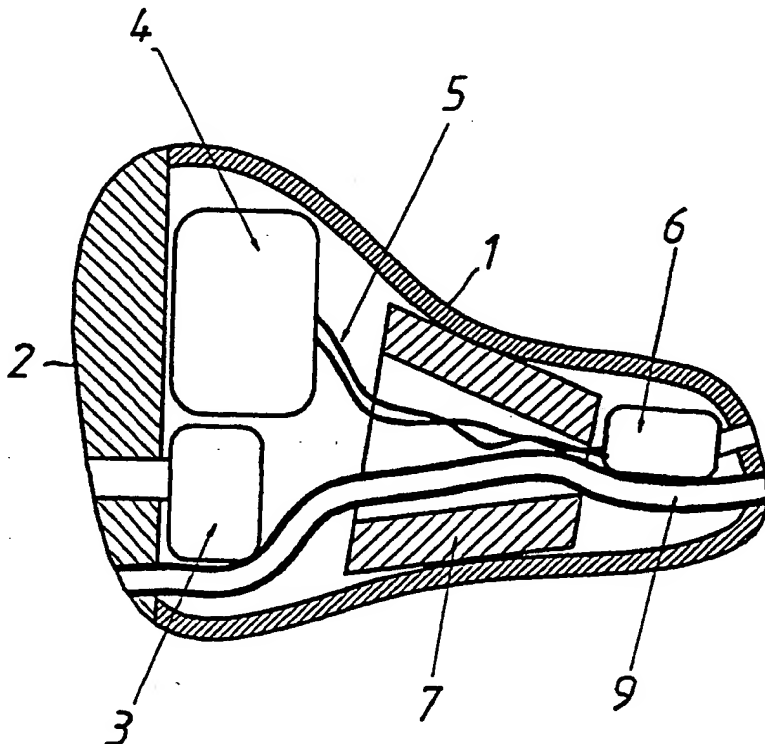
*With international search report.*

*Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.*

(54) Title: HEARING AID AND BATTERY FOR USE IN SUCH A HEARING AID

(57) Abstract

In a hearing aid consisting of a housing (1, 2), in which the various components (3-7, 9), inter alia a rechargeable battery (7), are placed, the most important new feature is that the battery (7) is shaped with a view to exploiting "spare room" in the housing (1, 2), in the example shown by being shaped like a cone with an opening (8), through which extend connecting leads (5) and a pressure equalization tube (9). With this arrangement, the space within the housing (1, 2) is utilized to the maximum possible extent, providing a large battery volume and consequently a high capacity.



Aa

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HEARING AID AND BATTERY FOR USE IN SUCH A HEARING AIDTECHNICAL FIELD

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The present invention relates to a hearing aid of the kind set forth in the preamble of claim 1.

10 BACKGROUND ART

For users of hearing aids of this kind, one of the most important desires is often that the hearing aid be so small that it can be concealed, either in or behind the ear. This makes it necessary for all components to be as small as possible, this naturally also applying to the battery. Small batteries do, however, unavoidably have a small capacity, for which reason they must be replaced correspondingly frequently, and this is not made easier by their small size, giving many users problems in handling them.

Now, when rechargeable batteries have appeared on the market, it would lie near at hand to substitute rechargeable batteries for the non-rechargeable batteries, by definition requiring to be replaced, and this idea has found an expression in FR-A1-2,688,645. The rechargeable batteries do, however, for each recharge typically have a lower capacity than that of the usual non-rechargeable or primary batteries. Thus, in order to avoid too frequent recharging operations it is necessary to use rechargeable batteries having a greater volume than the primary batteries having been used up to the present, but this will unavoidably give rise to a space problem. The publication

referred to above does not, however, appear to aim at solving this space problem, as the accumulator 3 mentioned in the publication is not described as being shaped in a manner hitherto unknown.

5

#### DISCLOSURE OF THE INVENTION

10 The present invention indicates a solution of the problem referred to above by providing the use of a battery with the features set forth in the characterizing clause of claim 1. With these features it is possible to achieve such a size of the battery that its capacity is sufficient for supplying energy to the hearing aid during an interval  
15 of time being acceptable for the user.

Admittedly, DE-A1-4,242,255 discloses a hearing aid, in which the rechargeable battery is constituted by a series of partial batteries being embedded in the wall of the  
20 housing. Thus, the battery is not an independent unit placed in the internal space of the housing together with the remaining components.

The present invention also relates to a battery for use  
25 with the hearing aid according to the invention. This battery is of the kind set forth in the preamble of claim 4, and according to the present invention, it exhibits the features set forth in the characterizing clause of this claim.

30

Advantageous embodiments of the hearing aid and the battery according to the invention, the effects of which - beyond what is obvious - will be evident from the following detailed part of the present description, are set

forth in claims 2, 3 and 5, 6, respectively.

#### BRIEF DESCRIPTION OF THE DRAWINGS

5

In the following detailed part of the present description, the invention will be explained in more detail with reference to the exemplary embodiments of a hearing aid according to the invention and parts of same shown in the drawing, in which

10

Figure 1 in longitudinal section shows a first exemplary embodiment of an "in-the-ear" hearing aid, Figure 2 is a perspective view showing a battery for use in the apparatus shown in Figure 1,

15

Figures 3 and 4 show a second exemplary embodiment of an "in-the-ear" hearing aid and its battery, respectively, shown in the same manner as in Figures 1 and 2,

Figure 5 in longitudinal section shows a first exemplary embodiment of a "behind-the-ear" hearing aid,

20

Figure 6 is a perspective view showing the battery used in the hearing aid shown in Figure 4, and

Figures 7 and 8 show a second exemplary embodiment of a "behind-the-ear" hearing aid and the battery used therein, respectively, shown in the same manner as in Figures 5

25

and 6.

#### DESCRIPTION OF THE PREFERRED EMBODIMENTS

30

The hearing aid of the "in-the-ear" type shown in Figure 1 comprises in a manner known in principle

- a housing 1, the end of which situated towards the right in the drawing is adapted to be placed in an external auditory meatus, whilst the end situated

towards the left is closed by

- a cover 2, on the inside of which is secured
- a microphone 3 acoustically connected to the surrounding air and electrically connected to the input of
- 5 - an amplifier 4, the output of which is connected through leads 5 to
- a sound-producing transducer 6, the acoustic output of which debouches in the part of the housing 1 adapted to be placed in the external auditory meatus.

10

Further, the hearing aid shown in Figure 1 comprises a battery 7 placed in the space between on the one hand the microphone 3 and the amplifier 4 and on the other hand the transducer 6, and which, due to its through opening 8, embraces partly the leads 5, partly a pressure equalization tube 9, the latter connecting the space in the external auditory meatus inside of the housing 1 with the surrounding air, when the hearing aid is used.

15

20 For the sake of good order it should be noted that the connections between the microphone 3 and the amplifier 4 and between the battery 7 and the amplifier 4 are not shown, but persons skilled in this art will know how to arrange and construct these connections.

25

Looking at Figure 1 makes it possible to realize that the battery 7 cannot readily be exchanged, such as is the case with the majority of hearing aids known up to the present. It is not, however, intended that the battery

30 7 is to be replaced with short intervals, being as it is a rechargeable battery.

By comparing the hearing aid shown in Figure 1, especially its battery, to one of the hearing aids commonly in use

at the present time as well as its battery, the latter normally being a small replaceable battery shaped like a pill or coin, it can be realized that the battery 7 according to the present invention has a considerably greater volume than the known battery. This is primarily made possible by the special shape of the battery 7, making it possible to make use of "spare room" in the housing 1. Since the battery 7 is intended to be placed more or less permanently in the housing 1, the usual contact means necessary in the case of replaceable batteries are not required, because the battery 7 can be connected to the amplifier 4 through e.g. simple soldered leads.

Since the battery 7 is of the rechargeable type, there is, of course, a need for being able to connect it to a suitable charging device. Such a connection can preferably be achieved by means of contact members (not shown) on the outside of the housing or - better still - the cover 2, adapted to be connected releasably with corresponding contact members connected to or placed on a suitable charging device (likewise not shown). The arrangement of the contact members on the hearing aid and on the charging device as well as the construction of the latter can preferably be such, that when the hearing aid is placed in or on the charging device in a predetermined position e.g. with the cover 2 resting in a disc-shaped recess in the charging device, connections between the current-supplying means in the charging device and the battery 7 will be established.

30

Figure 3 shows another example of a hearing aid of the "in-the-ear" type, in which the battery 7 embraces the microphone 3, and in this case, the leads 10 from the microphone 3 to the amplifier 4 can also be seen. Other-

wise, the same reference numbers as in Figure 1 are used. In this case also it will be seen that the battery 7 has a considerable volume and hence a correspondingly large capacity.

5

Figure 5 shows an example of a hearing aid of the "behind-the-ear" type, in which the housing 1 in a manner known per se is shaped as a curved box with generally flat sides, the latter in Figure 5 facing towards and away from the viewer, respectively. In this case also, generally the same reference numbers as in Figures 1 and 3 are used, but Figure 5 additionally shows a manually operable switch 11 and a sound tube 12 adapted to be connected acoustically with the external auditory meatus.

15

As may be seen from Figure 5 and not least Figure 6, the battery 7 is in this case in the shape of a box open at both ends, having a through opening 8 fitting snugly around the outer shape of the amplifier 4.

20

Figure 7 shows yet another example of a hearing aid of the "behind-the-ear" type, in which the battery 7 is plate-shaped and cut into shape so as to fit quite accurately the side wall in the housing 1 facing away from the viewer, or even fully or partly constitutes this side wall. In a similar manner, a further battery (not shown) can be placed close to or constitute a greater or lesser part of the wall (not shown) in the housing 1 facing towards the viewer.

30

Each of the exemplary embodiments shown in Figures 3, 5 and 7 may be adapted to be connected to a charging device in the manner referred to above with reference to Figure 1. It should be noted that the connection means, with



which the hearing aid and the charging device are connected to each other, can be of the galvanic type, i.e. based on direct contact between conductors, but it is also possible to transfer electrical energy for charging the battery by means of an alternating electromagnetic field produced by the charging device and intercepted in the hearing aid by a coil with an associated rectifier. A third possibility could be to use energy in the form of light, in which case the hearing aid would be equipped with at least one solar cell or photo-cell being radiated at suitable intervals by the sun and/or a powerful lamp adapted for the purpose.

The batteries intended for use in the hearing aid according to the present invention may be of any kind capable of functioning even though their shape differs from the usual "geometrical" shapes, such as the shape of a pill, a coin, a cylinder or a parallelepiped.

LIST OF PARTS

|    |    |                            |
|----|----|----------------------------|
|    | 1  | housing                    |
|    | 2  | cover                      |
| 5  | 3  | microphone                 |
|    | 4  | amplifier                  |
|    | 5  | leads                      |
|    | 6  | transducer                 |
|    | 7  | battery                    |
| 10 | 8  | through opening            |
|    | 9  | pressure equalization tube |
|    | 10 | leads                      |
|    | 11 | switch                     |
|    | 12 | sound tube                 |
| 15 |    |                            |

C L A I M S

1. Hearing device of the kind comprising
    - a) a housing (1,2), inside of which are placed
    - 5 b) a microphone (3) adapted to receive sound coming from outside,
    - c) a sound-producing transducer (6) adapted to deliver sound to a human ear,
    - d) a signal processing unit (4) adapted to process
    - 10 signals from the microphone (3) and transmit the signals in a processed state to the sound-producing transducer (6), as well as
    - e) a rechargeable battery (7) constituting an independent unit and adapted to deliver electrical current
    - 15 to the signal processing unit (4),

c h a r a c t e r i z e d i n

  - f) that the external shape of the battery (7) differs from the shapes similar to a pill, a coin, a cylinder or a parallelepiped until now commonly used, said
  - 20 external shape being adapted to the shape of at least one cavity in said housing (1,2) not being occupied by one or more of the components referred to in items b, c and d above or their connecting leads.
  - 25
2. Hearing aid according to claim 1, c h a r a c -  
t e r i z e d i n that the battery (7) comprises an open-  
ing extending right through the battery and surrounding  
at least one of the components mentioned and/or the con-  
necting leads between at least two of them.
  - 30
3. Hearing aid according to claim 1 and in which at least one of the walls limiting said housing (1,2) has a not inconsiderable size compared to the housing,

10

c h a r a c t e r i z e d in that the battery (7) is shaped according to and placed closely adjacent to or fully or partly constitutes the limiting wall or walls mentioned.

5

4. Rechargeable battery (7) for a hearing aid according to any one or any of the claims 1-3, c h a r a c t e r -  
i z e d in that the external shape of the battery (7)  
differs from the shapes similar to a pill, a coin, a  
cylinder or a parallelepiped until now commonly used, said  
external shape being adapted to the shape of at least  
one cavity in said housing (1,2) not being occupied by  
one or more of the components referred to in items b, c  
and d in claim 1 or their connecting leads.

15

5. Battery according to claim 4, c h a r a c t e r -  
i z e d by an opening (8) extending right through the  
battery and adapted to surround at least one of the com-  
ponents mentioned and/or the connecting leads between at  
least two of them.

20

6. Battery according to claim 4 and intended for use  
with a hearing aid according to claim 3, c h a r a c -  
t e r i z e d in that it is shaped according to and  
adapted to be placed closely adjacent to the limiting  
wall or walls mentioned in claim 3 or to constitute said  
wall or walls partly or fully.

25

1/4

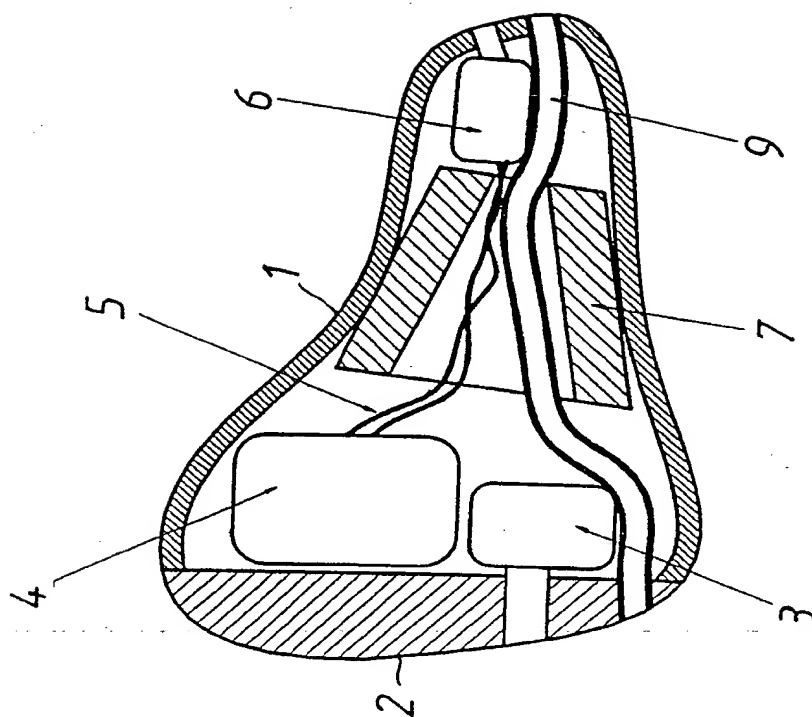


Fig. 1

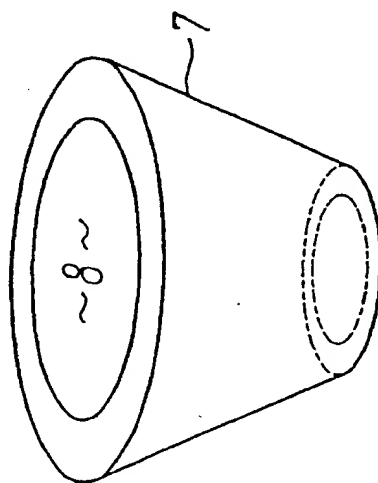


Fig. 2

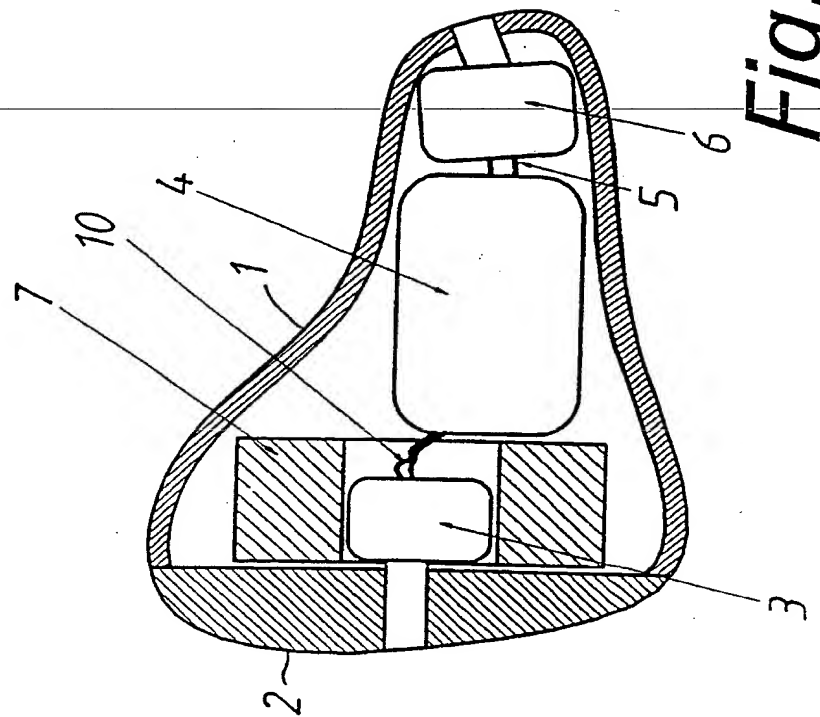


Fig. 3

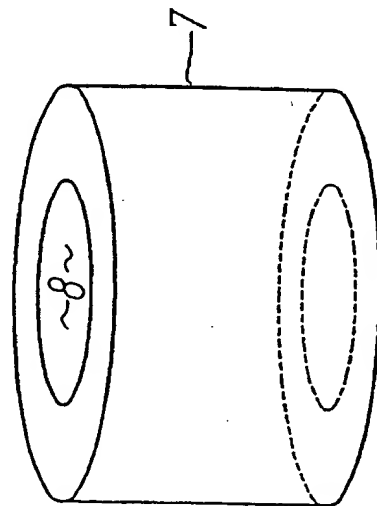


Fig. 4

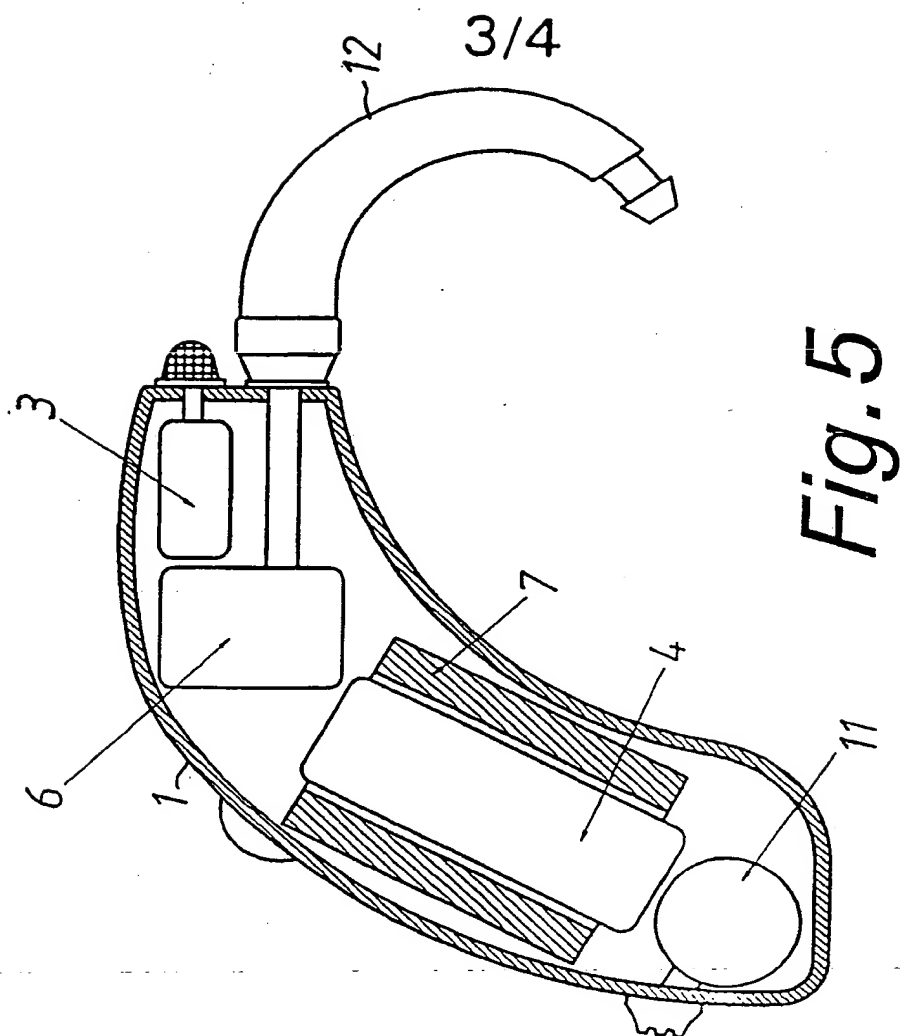
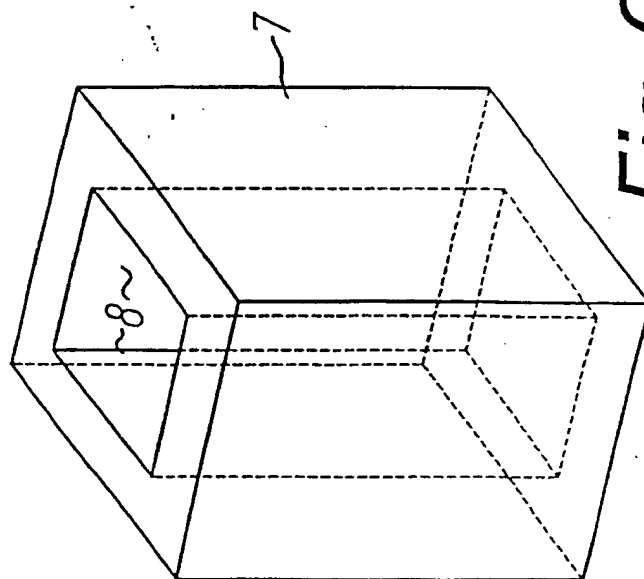


Fig. 6



4/4

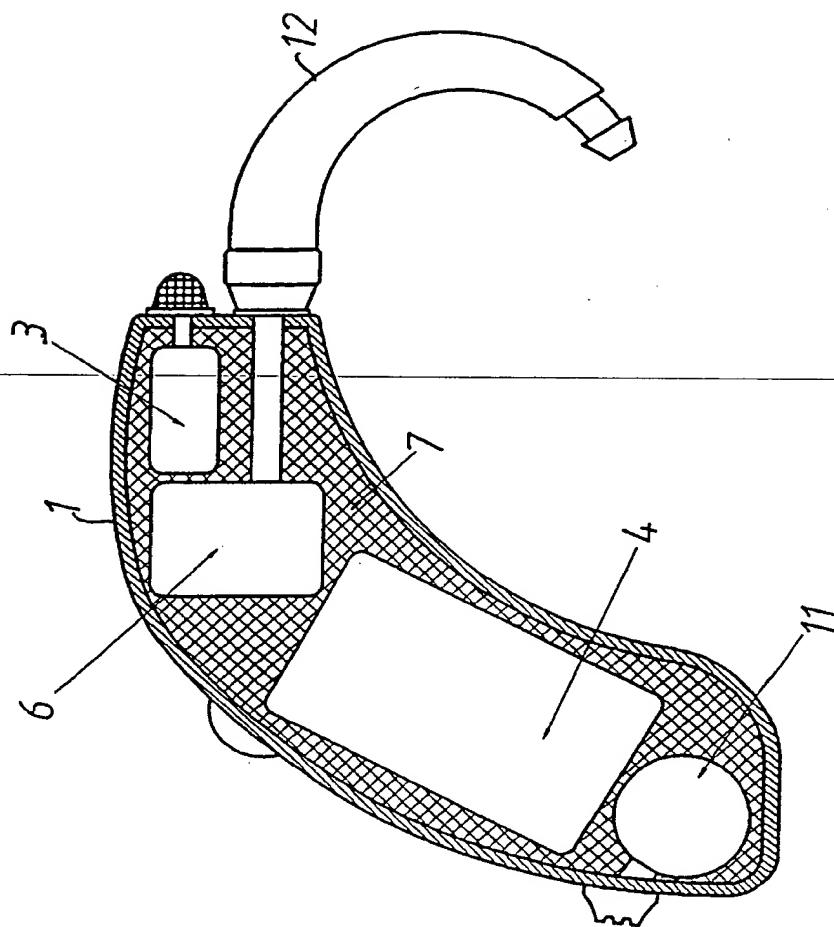


Fig. 7

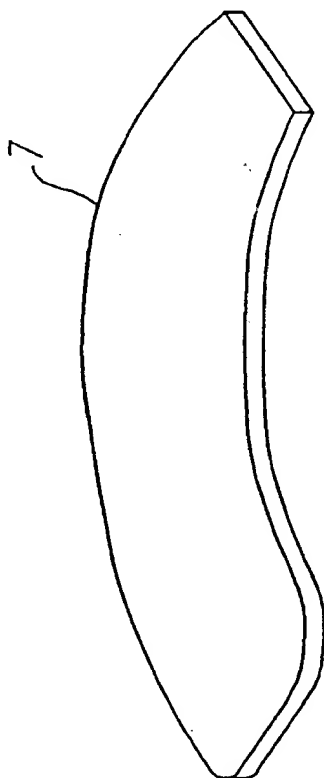


Fig. 8



## INTERNATIONAL SEARCH REPORT

International application No.

PCT/DK 96/00328

## A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H04R 25/02

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H04R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages   | Relevant to claim No. |
|-----------|--|-----------------------|
| X         | DE 4241255 A1 (SCHULTZE, GÜNTHER), 15 April 1993<br>(15.04.93)<br>--   | 1-6                   |
| A         | WO 8908370 A1 (ALMÁSI, ISTVÁN ET AL), 8 Sept 1989<br>(08.09.89), see elements 2, especially in fig 2,<br>and accompanying text<br>-- | 2,3,5,6               |
| A         | US 4614695 A (IBBOTT), 30 Sept 1986 (30.09.86),<br>see especially column 2, line 54 - column 3, line<br>8<br>--                      | 4-6                   |
| A         | US 3007992 A (K. LEHOVEC), 7 November 1961<br>(07.11.61), see especially column 2, line 45-55<br>--                                  | 4,5                   |

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

## \* Special categories of cited documents:

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
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Date of the actual completion of the international search

18 November 1996

Date of mailing of the international search report

28 - 11 - 1996

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## INTERNATIONAL SEARCH REPORT

International application No.

PCT/DK 96/00328

**C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT**

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|-----------|--|-----------------------|
| A         | US 3023259 A (M.A. COLER ET AL), 27 February 1962<br>(27.02.62), see especially column 1, line 8-11 and<br>20-22<br><br><div style="text-align: center;">             --<br/>             -----           </div> | 4,5                   |
|           |  |                       |

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/DK 96/00328

## Box I Observations where certain claims were found unsearchable (Continuation of Item 1 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
  
2. ☐ Claims Nos.:  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
  
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box II Observations where unity of invention is lacking (Continuation of Item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

Claim 1 states a hearing device of the kind comprising a housing, inside which is placed a rechargeable battery. Claims 3 and 6 state that the battery may constitute the wall of the housing partly or fully, in which case the battery is not placed inside the housing. Thus, claims 3 and 6 include inventions that are not according to the invention claimed in claim 1.

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
  
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.  
☐ No protest accompanied the payment of additional search fees.

## INTERNATIONAL SEARCH REPORT

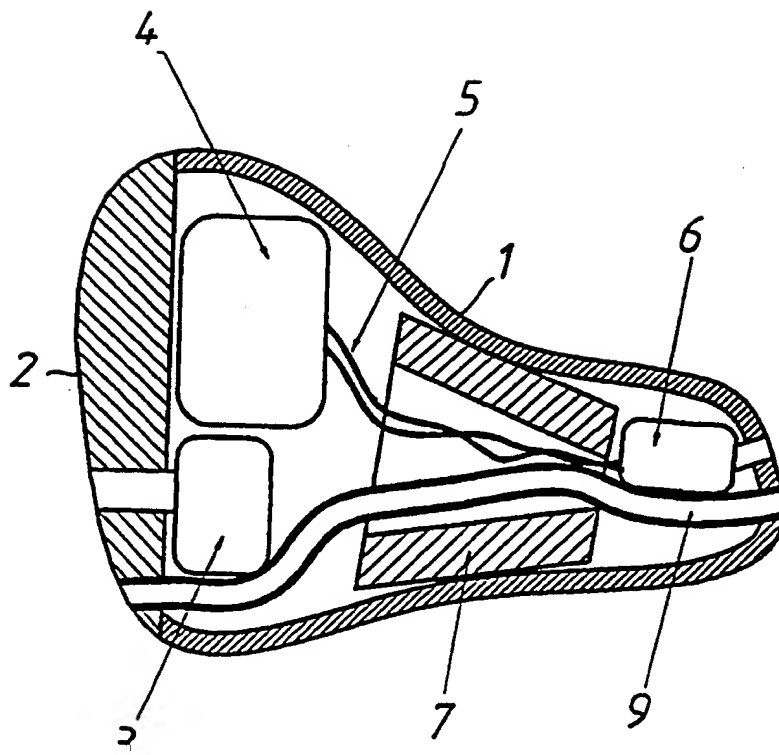
Information on patent family members

28/10/96

International application No.

PCT/DK 96/00328

| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
|---|---------------------|----------------------------|---------------------|
| DE-A1- 4241255                            | 15/04/93            | NONE                       |                     |
| WO-A1- 8908370                            | 08/09/89            | NONE                       |                     |
| US-A- 4614695                             | 30/09/86            | AU-B- 574021               | 23/06/88            |
|   |                     | AU-A- 2695484              | 09/10/84            |
|   |                     | EP-A,B- 0139014            | 02/05/85            |
|   |                     | SE-T3- 0139014             |                     |
|   |                     | JP-C- 1880432              | 21/10/94            |
|   |                     | JP-A- 59169071             | 22/09/84            |
|   |                     | WO-A- 8403801              | 27/09/84            |
| US-A- 3007992                             | 07/11/61            | NONE                       |                     |
| US-A- 3023259                             | 27/02/62            | NONE                       |                     |



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